SPECIAL REPORT AMR-AS-05-01

2005 "BLUE BOOK" SCIENCE AND TECHNOLOGY PROGRAM COMPENDIUM

Advanced Science and Technology Directorate
Aviation and Missile Research, Development, and Engineering Center

April 2005

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AMRDEC
STRENGTH THROUGH TECHNOLOGY

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
00 APR 2005	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
2005 "Blue Book" Science And Technology Program Compendium	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Advanced Science and Technology Directorate Aviation and Missile Research, Development, and Engineering Center**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**UU**	**49**	

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INTRODUCTION

The primary purpose of the "Blue Book" is to provide an accessible and current source of information for use in briefing individuals within the Department of Defense on programs defined in the Aviation and Missile Army Science and Technology Management Information System (ASTMIS). The "Blue Book," composed of a single chart on each of the programs, is a living document and will be updated as the Aviation and Missile ASTMIS program is revised.

Programs in ASTMIS are funded programs. Thus, the appropriate Program Element (PE) and project reference numbers are provided in the table of contents to show the relationship of funding to the programs. For ease of navigation through the document, the list of program titles in the table of contents is hyperlinked to the corresponding program briefing chart. Immediately following the briefing charts is a list of acronyms and abbreviations used in the charts.

This document has been prepared mainly for use by members of the combat development community. Additionally, those individuals who work as liaisons with the Training and Doctrine Command may find this document a useful source of information during visits.

Point of Contact for additional information regarding the "Blue Book" is Stephen L. Drzycimski, 256-313-1955, Stephen.drzycimski@us.army.mil.

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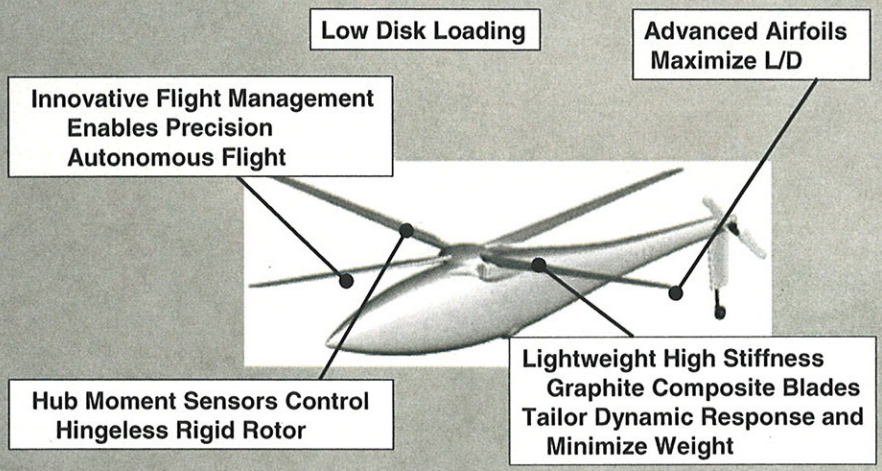
A-160 Hummingbird

Optimum Speed Rotor (Patented)
Adjusts RPM 50%-100% to Optimize Performance



Schedule and Cost

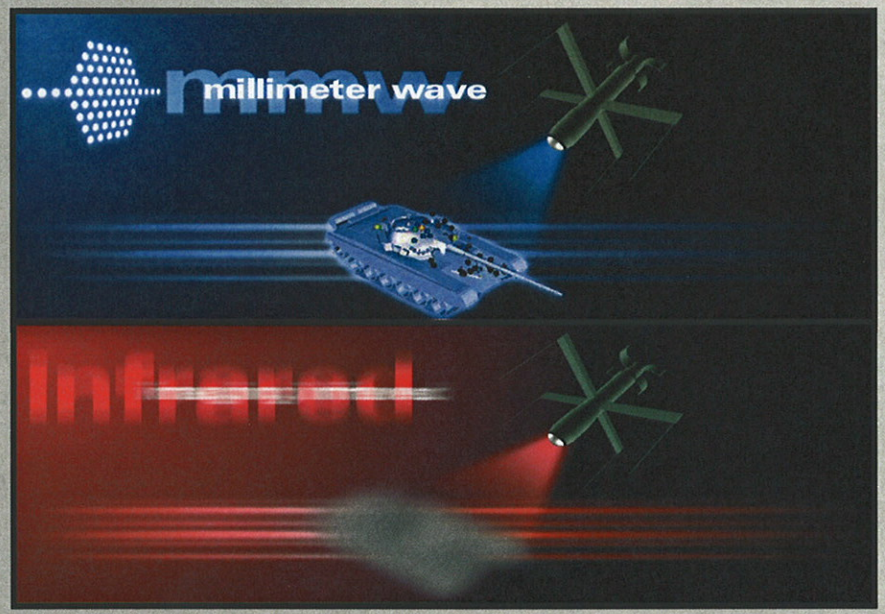
Milestones	*FY03*	*FY04*	*FY05*	*FY06*	*FY07*
Phase 0 (AV 001-003) Flight Test					
Phase 1 Subsytem Ground Test (less engine & transmission)					
Phase 1 AV Fabrication & Mods					
Phase 1 GCS Fabrication					
Phase 1 (AV 004-009) Flight Test					
Program Reviews		▲	▲	▲	▲

Purpose:
Provide capability to have a VTOL UAV with Predator-like vehicle performance to provide C4ISR to the legacy and objective forces.

Product:
Six sensor equipped air vehicles with three ground stations. Sensors will include EO/IR and SAR/GMTI packages.

Payoff:
- ***Dominant situational awareness on future battlefields***
- ***Persistent stare and companion vehicle capabilities***
- ***Class IVb UAV (FCS ORD)***
- ***ER/MP candidate***

A214 SS-01 Missile Simulation Technology



Purpose:
Provide capability to produce detailed hardware-in-the-loop simulations with accurate and realistic target signatures and sensor scene backgrounds to support development, production, and fielding of future missiles.

Product:
Technology and tools (hardware and software) to permit accurate evaluation of missiles and operational concepts by means of hardware-in-the-loop simulations.

Payoff:
Improved, cost-effective capabilities for development, production, and fielding of future missiles and operational concepts. Transition into use in simulation facilities immediately as the technology and tools become available.

SCHEDULE AND COST

Milestones/Tasks	*FY05*	*FY06*	*FY07*
• *PERLSHELL/LINUX Script for ASC Facility Control Programs*			
• *S- and C-Band RCS Prediction Methods and Codes*			
•*LADAR and IR Scene Generation Methodology*			

Active-Passive Aircraft Survivability (APAS)

Integrated Survivability to Defeat MANPADS

MILESTONES	FY05	FY06	FY07	FY08	FY09	FY10
Develop Adaptive IR Suppressor System						
Integrate Passive IR						
Integrate Active CM & Threat Warning						
Flight Demo						

Objective:

Develop and demonstrate a lightweight, low cost aircraft self–protection suite that is effective in defeating current Man Portable Air Defense System (MANPADS) threats.

Description:

- *Adaptive engine IR suppressor system*
  - *75% reduction in exhaust IR signature*
  - *3% increase in available engine power*
- *Super-lightweight thermal insulation*
- *Multi-spectral airframe coatings*
- *Lightweight, low cost omni-directional IR jammer (CERDEC)*
- *CMWS missile warning system*
- *Small arms & RPG threat warning (RDECOM)*

Approach:

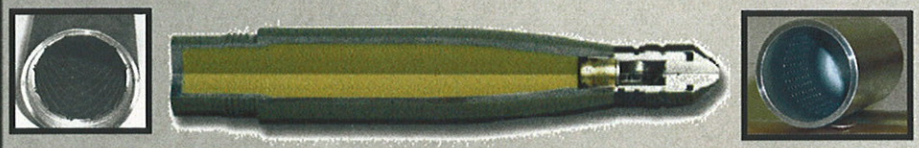
- *Reduce aircraft signatures to delay threat acquisition and degrade engagement performance*
- *Utilize omni-directional jammer to reduce countermeasure latency*
- *Integrate small arms and RPG threat warning system*
- *Demonstrate 50% increase in probability of survival against MANPADS threats*

Payoff:

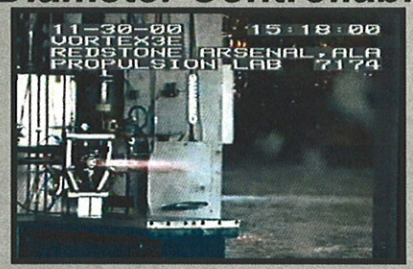
- *Increased survivability of warfighter and aircraft*
- *Transitions to:*
  - *Intelligent Decision Aiding for Survivability (IDAS)*
  - *Apache Block III, FY08*
  - *A-160 Phase II FY08*

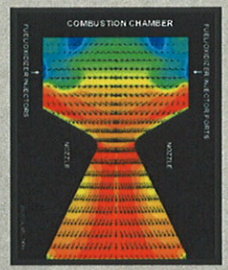
Advanced Miniature Multi-Role Precision Guided Missile (AMMPGM) Technology

Enhanced Multi-Purpose Warhead



Small Diameter Controllable Thrust Propulsion





Schedule & Cost

MILESTONES (ARL / AMRDEC)	02	03	04	05	06	07	08
Enhanced Blast/Frag Warhead/Fuze							
• Preliminary Investigation/Test							
• Candidate Evaluation							
• Optimized Design/Test							
• Final Warhead Design/Test							
Controllable Thrust Propulsion							
• System Level Concept Design/Trades							
• Hardware Design/Fabrication							
• Component Test/Evaluation							
• Integrated System Level Test							
• CFD Design Tool Dev/Validation							

Purpose:

Develop and demonstrate enhanced blast/frag warhead and extended range propulsion subsystems in support of APKWS Evolutionary Acquisition Strategy.

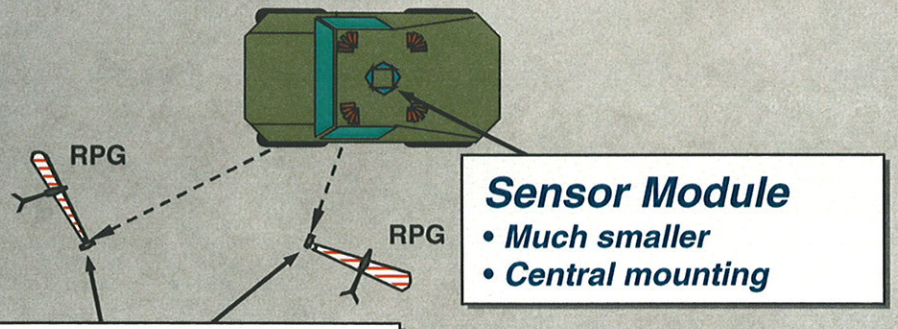
Product:

- *Mature, fully form factored and integrated enhanced blast/frag warhead and multi-function fuze*
- *Prototype controllable thrust propulsion subsystem capable of doubling the range in same form factor*

Payoff:

- *Increased lethality*
- *Increased standoff and survivability*
- *Enhanced blast/frag warhead/fuze transitions to APKWS P3I Program at end of FY05 (PEO Tactical Missile)*
- *Controllable thrust propulsion transitions to APKWS P3I Program at end of FY07*

Close-In Active Protection System (CIAPS)



Schedule and Cost

Milestones	FY04	FY05	FY06
Demonstrate & Transition Phase I, LAV			
Concept Phase II, Tactical Wheeled Vehicle			
Design & Demonstrate Phase II Components			
Integrate Phase II Prototype on HMMWV			
Demonstrate & Transition Phase II for Tactical Wheeled Vehicles			

Purpose:

Increase survivability by providing current and future ground systems with a capability to actively defeat RPG type threats.

Products:

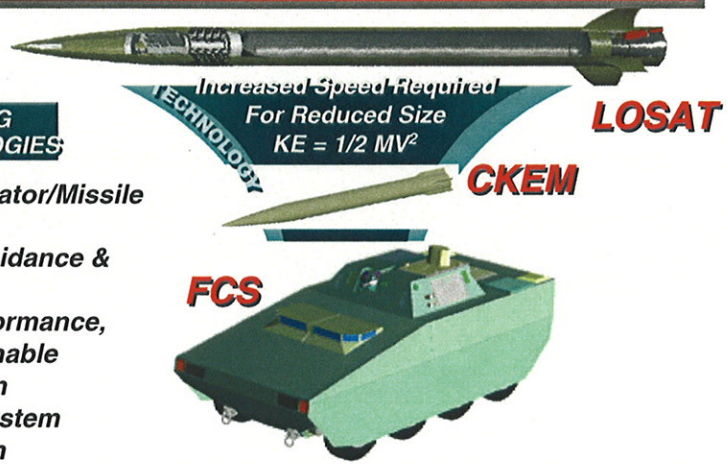
- *Phase 1 demonstrated prototype able to fit light armored vehicles*
- *Phase 2 demonstrated prototype able to fit tactical wheeled vehicles*
- *Validated simulations for tailoring to specific vehicle classes*

Payoff:

- *Protect light vehicles from RPGs fired from ambush without warning*
- *Specific transitions plans (e.g. transitions to…PEO CSS in FY06 for SDD)*

Compact Kinetic Energy Missile

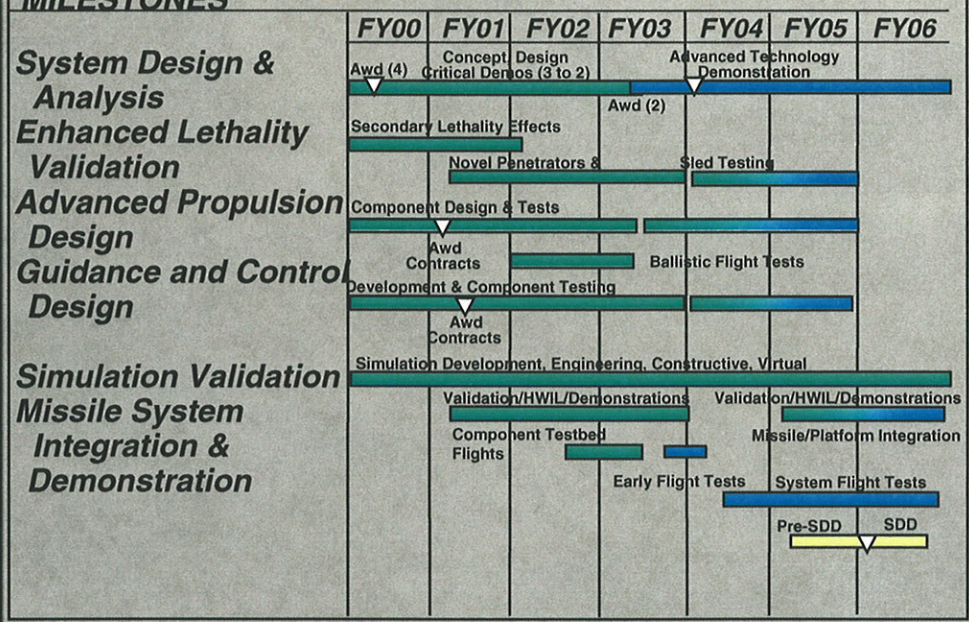
Smaller, Lighter, Faster Hypervelocity Missile
Providing Overwhelming Lethality Against Future Threat Targets



PACING TECHNOLOGIES

- KE Penetrator/Missile Lethality
- High-g Guidance & Control
- High Performance, Non-Detonable Propulsion
- Missile/System Integration

Schedule and Cost



Purpose:

Demonstrate "overwhelming lethality" capability with a smaller, lighter, faster kinetic energy missile.

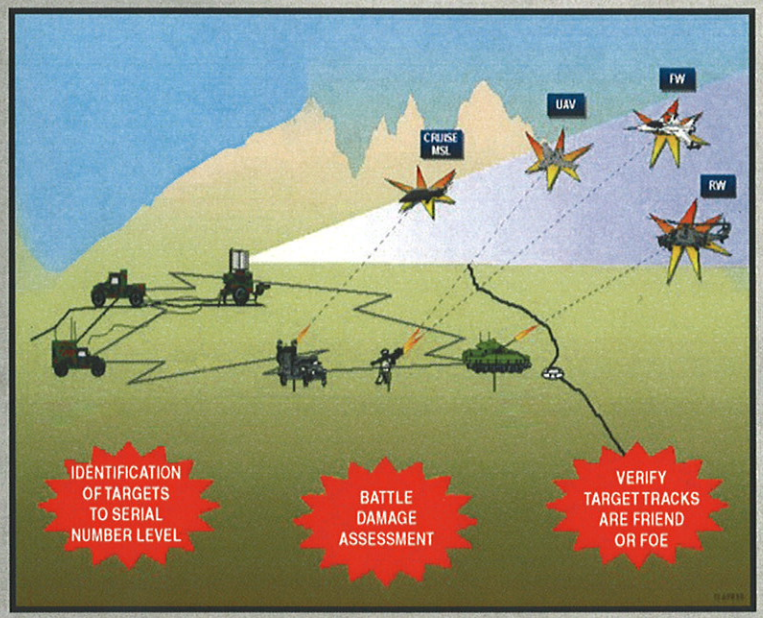
Product:

- Direct-Fire LOS Weapon System:
  - "LOSAT-Like" Lethality at ~ Half the Size and Mass
  - High Pk Over Extended Ranges
    - "Overwhelming effects" (perforation, mass-momentum & energy transfer)

Payoff:

- "Overwhelming Lethality"
- Target Set: Advanced Armored Systems (APS, ERA) and Hard Point Targets, Bunkers, and Buildings
- Effective Over Extended Ranges
- Lightweight Quick Kill
- Large Quantity KE Stowed Kills – Rapidly Deployable
- Missile Fire on the Move Capability
- Platform Compatible with Stryker, FCS/OF, HMMWV
- ATD Transitions to CCWS PM
- Potential Capability in FCS Increment I

Cruise Missile Defense Via RF Altimeter Detection



Schedule and Cost

MILESTONES	*FY04*	*FY05*	*FY06*	*FY07*	*FY08*
Algorithm Development					
Integrate New RF and Signal Processing Components					
Demonstrate First Generation Prototype @ Red Flag 05					
Prototype Hardware Ready for Experimental Validation					
Detection and SEI Algorithm Improvements					

Purpose:

Provide future forces with a highly mobile, highly accurate capability to detect, track, identify, engage, and destroy cruise missiles.

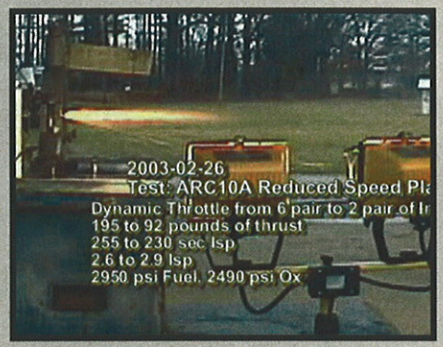
Product:

Two passive RF detection systems capable of detecting, identifying, and tracking CM RF altimeters with sufficient angle and identification accuracy to support firing decisions.

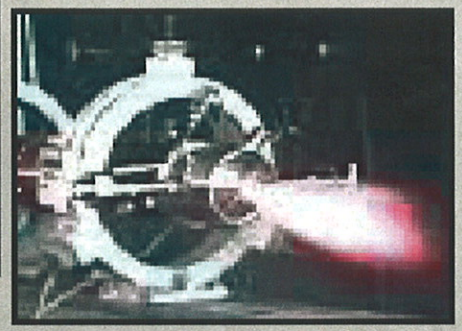
Payoff:

- ***Provide increased maneuver force protection through BVRE capability against CMs and other small targets for limited investment***
- ***SENTINEL PO in FY06 for SDD***

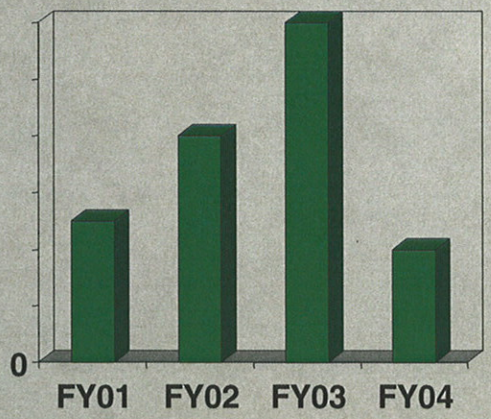
Deep Throttling Booster



Throttling Vortex
12:1 Thrust Turndown



Throttling Solid
15:1 Thrust Turndown



Purpose:

- *Provide capability to increase range and flexibility of missile systems within the weight /volume constraints of existing and future Army launch platforms*
- *Improve insensitive munitions capability*

Product:

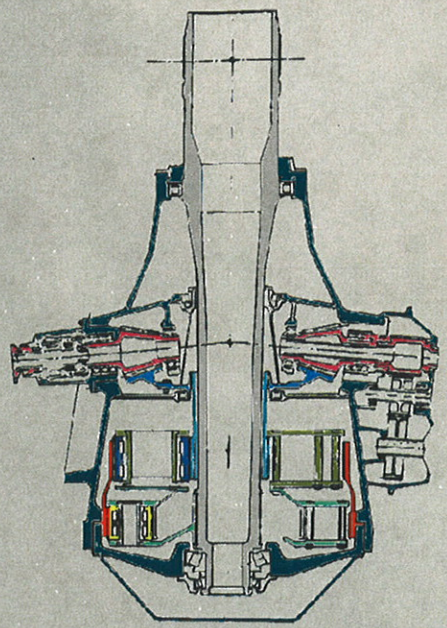
Throttleable gel vortex engine and a trottleable solid with an active variable area nozzle.

Impact:

- *Increased range and mission flexibility (60-80% increase in area coverage)*
- *Greater standoff enhancing survivability*
- *Shorter time of flight to intermediate ranges*
- *Enhanced end game performance*
- *Transitions to NLOS-LS technology STO supporting Spiral Development (FY04)*

Vision: Survivable, Controllable Thrust Propulsion for Future Army Missiles

Enhanced Rotorcraft Drive System



Program Objectives:

Develop and demonstrate advanced drive system technologies that will provide enhanced, reliable power transmission systems for Army rotorcraft at very low cost of ownership.

- ***Increase Power-to-Weight Ratio 40%***
- ***Reduce Transmission Noise 15db***
- ***Reduce Production & Maintenance Costs by 30%***

Technical Challenges:

- ***High-speed reduction in a single stage***
- ***Reliability of lightweight, highly loaded precision components***

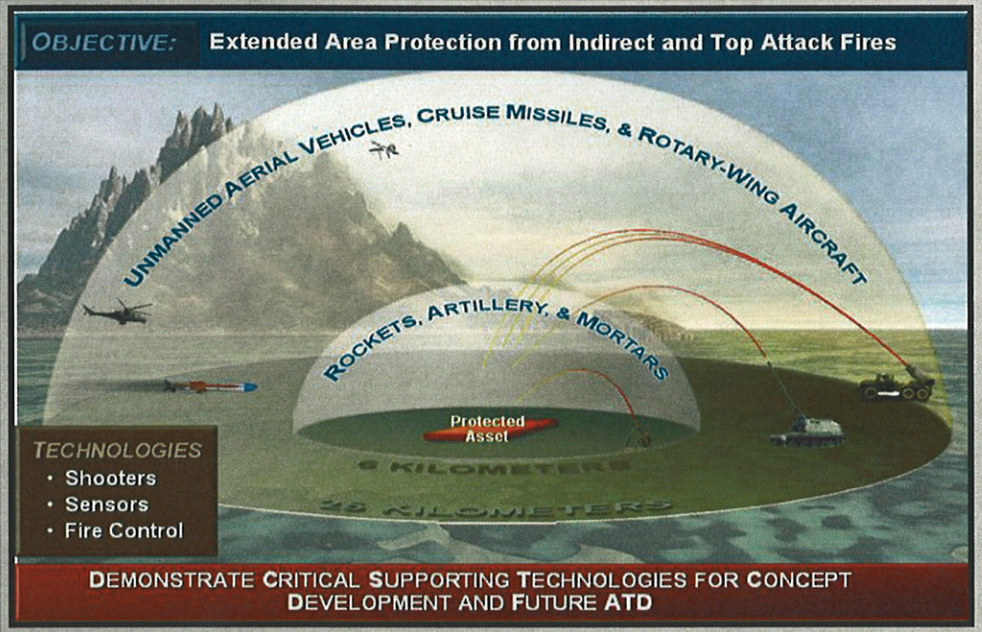
Payoffs:

- ***Increased SHP/WT provides A/C with increased range and payload capability***
- ***Reduced O&S costs and production costs increase aircraft affordability***
- ***Supports manned and unmanned aircraft***

Schedule and Cost

Milestones	FY06	FY07	FY08	FY09	FY10
Design					
Fabrication					
Assembly					
Test / Evaluation					

Extended Area Protection & Survivability (EAPS)



Schedule and Cost

MILESTONES	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11
Threat Validation								
System Analysis								
Lethal Mechanism								
• Technical Trades								
• Demonstration								
Interceptor (Shooter)								
• Technical Trades								
• Critical Tech Demos								
Integrated System Demos								
System Simulation								

Purpose:

Demonstrate critical supporting technologies to enable stationary/mobile 360-degree hemispherical extended area protection from direct and indirect fires, including RAM, UAV, and CM threats.

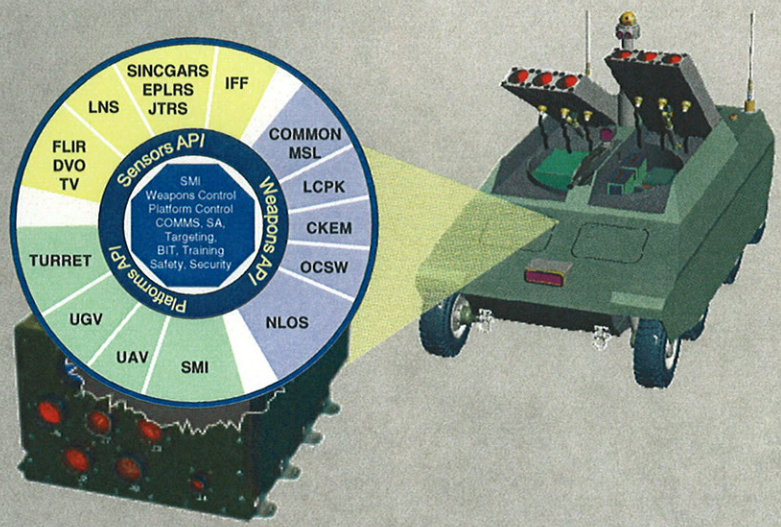
Product:

- ***Demonstration of form factored, low cost, lethal mechanisms to defeat RAM, UAV, and CM threats***
- ***Demonstration of critical supporting shooter, sensor, and fire control technologies, including simulation models***
- ***Demonstration through HWIL and simulation feasibility of integrated system solutions to provide robust area protection***

Payoff:

- ***Provides extended area protection from direct and indirect fires, including RAM, UAV, and CM threats***
- ***Reduced logistics and maintenance***
- ***Distributed survivability across the force***
- ***Transitions to EAPS ATD in FY08***
- ***Continuous spiral transition to PM AMDCCS, Counter Mortar System (CMS)***

Fire Control Node Engagement Technology (FC-NET)



Schedule and Cost

Milestones	*FY02*	*FY03*	*FY04*	*FY05*	*FY06*
Feasibility Demonstration					
Interface Demonstration					
Technical Demonstration					
Distributed Demonstration					

Purpose:

Develop a common Fire Control (FC) system for the Army's Future Combat Systems (FCS) family of vehicles that seamlessly integrates FCS lethality platforms/nodes, sensor nodes, and decision nodes into a highly flexible, tailorable, and responsive networked SoS capable of optimized delivery of effects on target(s).

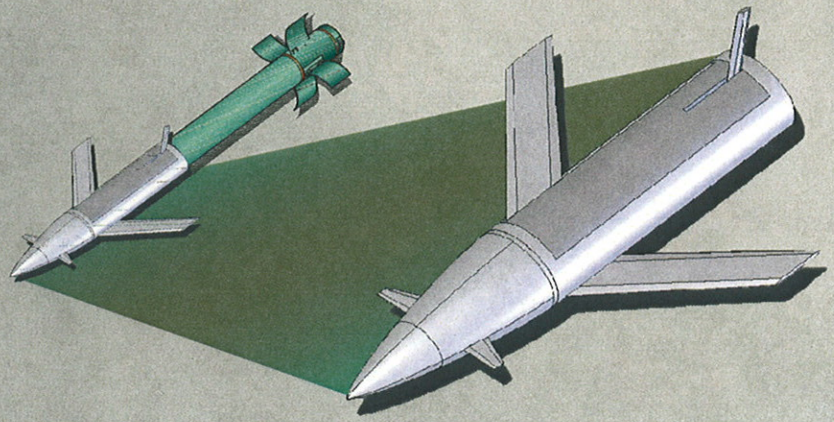
Product:

Open application programming interface(s) common multi-weapon technical fire control architecture with real time weapon-target pairing and distributed fire control solutions.

Payoff:

- ***Warfighter TWP aid through common HTI application: cross service interoperability, single fire control for multi-missions (indirect/direct fire)***
- ***Lower ownership cost, enhanced lethality and survivability, exploit situational awareness***
- ***Major step towards networked fires and effects***

GMLRS CARGO Round Technology



Schedule and Cost

MILESTONES	FY 04	FY05	FY06
•System Requirements			
•Warhead Design			
•Wing Mechanism			
•Payload			
•Separation System			
•Dispenser System			
•Wind Tunnel			
•Guidance and Control			
•Hardware-In-The-Loop			
•TM			
•Air Drop			
•Flight Tests			

Purpose:

Provide capability to carry and dispense multiple types of payloads with a common bus.

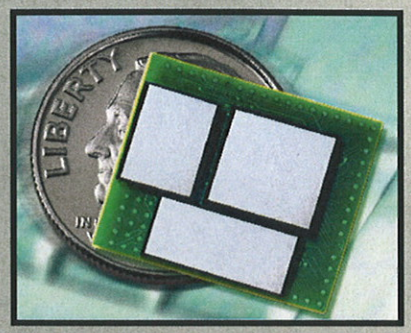
Product:

- *Demonstrated novel airframe to carry, fly-out, maneuver and dispense multiple payloads*
- *End-to-end simulation with high fidelity cargo round fly-out and maneuvers*

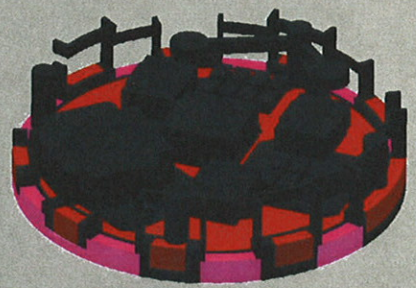
Payoff:

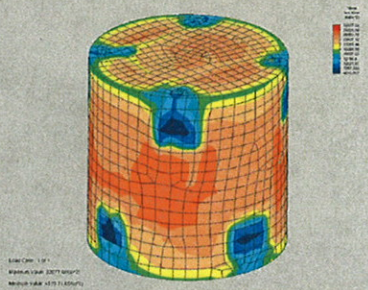
- *Extreme commander flexibility (multiple payloads, increased ranges, multiple payload dispense scenarios)*
- *Transitions to PEO Tactical Missiles for PFRMS GMLRS-Unitary through horizontal technology insertion (FY06 For CAD and SDD In FY06)*

Guidance Electronics Miniaturization and Structronics (GEMS)



- FPGA, Microprocessor, EEPROM, DRAM
- Each subcomponent testable
- >400 internal chip-to-chip connections
- 12.4 mm x 14.5 mm package size
- 0.94 mm package height
- 600% smaller; 1000% lighter
- High reliability; high performance





Purpose:

Develop, test, and transition miniaturized electronics packaging technology into AMRDEC missile programs to decrease flight electronics weight, space, and power footprint.

Products:

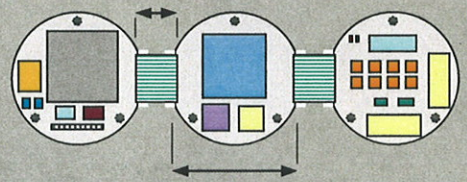
Miniaturized electronics suitable for small diameter missiles and munitions.

Payoff:

- ***Increased Missile Lethality and Range***
- ***Transition to SLC, NLOS-LS STO, EAPS, L-RAM***

Schedule and Cost

MILESTONES	*FY05*	*FY06*	*FY07*	*FY08*	*FY09*
Miniaturized Electronics					
Structronics					



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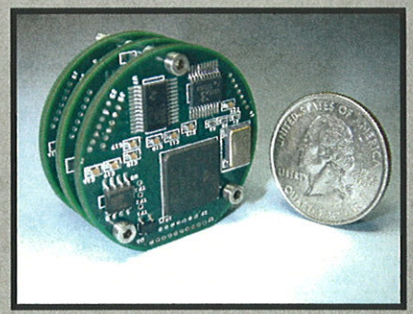


Hardened Combined Effects Penetrator Warheads

Schedule and Cost

MILESTONES	FY04	FY05	FY06	FY07	FY08
• Baseline Modeling/Testing					
• Define Bash-Thru Loads for Key Targets					
• Develop Appropriate "Hardening" Techniques					
• Incorporate Hardening, Enhanced Energetics and Frag into w/h Design					
• Model Designs/Eval Shortfalls					
• Optimize Designs/Build Prototypes					
• Integrated Demos Against Targets/Eval					
• Redesign & Scale					
• Final Integrated Demo					

Purpose:

Provide overmatch lethality using a single warhead that defeats armor, bunkers, personnel, and UAVs. Provides hardened capability to bash-through detonate within urban structures and clear rebar. This program supports LOS/NLOS/BLOS gun and missile systems.

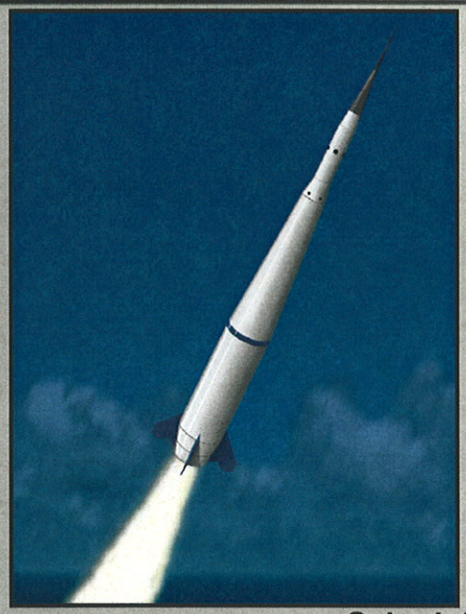
Product:

- ***Warhead subcomponent and munition integrated demonstrations***
- ***TRL6 Near Tactical Warheads***
- ***MRM, NLOS-LS, PGMM, Common Missile and APKWS warheads***
- ***LOS/NLOS/BLOS warhead technology***

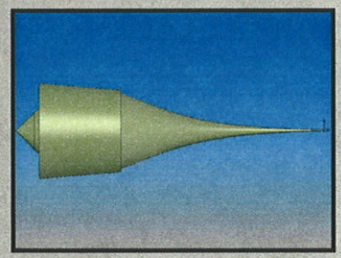
Payoff:

- ***Increased lethality over a broader range of targets, improved effectiveness against ERA & APS, increased stowed kills***
- ***Specific transition plans: Ammo & Tactical Missiles for SDD; PM CM, PM-MAS, PM NLOS-LS, PM-CAS, PM-ARMS SDD developments (FY06, FY07, FY08)***

Hypersonic Engine Demonstration/NAI



Mach 12, H2 Fueled Axisymmetric Scramjet Engine



Schedule and Cost

MILESTONES	*FY05*	*FY06*	*FY07*	*FY08*	*FY09*
Component Trade Studies					
Pre-Component Design					
Pre-Engine Ground Test					
Detailed Engine Design					
Engine Fabrication					
Engine Ground Tests					

Purpose:

To develop hypersonic air breathing propulsion and related technologies to enhance capability in army fire support, air defense, and cruise missile defense missions.

Product:

Mach 12, H2 fueled scramjet engine ready for transition to weapons program.

Payoff:

- ***Active defense against CMs, ICBMs, IRBMs, and MRBMs with Weapons of Mass Destruction (WMD) and other time-critical targets with shorter times of flight (>2x reduction in response time) to provide increased lethality and extended range engagements (2x)***
- ***Enhanced lethality & survivability (greater mutual support range, faster missile, more energy on target)***

Transitions:

- ***Potential transition of H2 scramjet to ATACMS/HIMARS system improvement programs, Long Range CM/UAV intercept for AMD Increment 3***

IR Seeker CCM for the Laser Threat

Schedule and Cost

MILESTONES	FY03	FY04	FY05	FY06	FY07
Level II (Electronic/Algo)					
HITL CM Assessment	▬	▬	▬		
Simulation/Modeling	▬	▬	▬		
Skr Lab, HITL & Field Tests					
Level II (Optical)					
Design & Development	▬	▬	▬	▬	
Component Devel & Fab	1st Gen		2nd Gen	▬	▬
Compon Lab & Skr HITL Tests					
Level III HITL CM Assessment		▬	▬	▬	▬
Simulation/Modeling	▬	▬	▬	▬	▬
Component Development			▬	▬	
Lab & HITL Tests					

Purpose:

Provide capability to harden future IR seekers (and multimode seekers) against dazing and damaging laser CM.

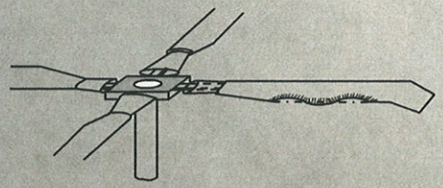
Product:

Technologies, simulations, test data, reports documenting CCM solutions.

Payoff:

- *Missile systems with laser CM resistant seekers will maintain lethality in the anticipated IRCM environment of the future battlefield*
- *Technology available to*
  - *–Common Missile SDD Phase II*
  - *–NLOS-LS SDD Block II*

Lightweight Active Rotor Concept



Advanced Rotor Technology

- ***Lightweight rotor***
- ***Active on-blade control***

Schedule and Cost

Milestones	*FY05*	*FY06*	*FY07*	*FY08*
Computational Fluid Dynamics Simulation				
Bench Test Most Promising Advanced Rotor Technologies				
Integrate Technologies into Model Rotors				
Evaluate Primary Flight Control				
Test Performance in Wind Tunnel				

Purpose:

Demonstrate performance enhancements gained from advanced rotor technologies, including on-blade controls.

Products:

- ***Lightweight active rotor design that eliminates the swashplate***
- ***Active on-blade control system test data***
- ***Improved analytical design tools***

Payoff:

- ***Provide the warfighter the capability to increase range (~40%) or payload (~30%) while reducing rotor O&S costs by ~30%***
- ***Potential application to current fleet and Future Force (Joint Multi Role, Joint Heavy Lift)***

Line of Sight Smaller, Lighter, Cheaper (LOS-SLC)

Search, Detect, and Engage LOS Targets in a Specified Area

MILESTONES	FY05	FY06	FY07	FY08	FY09	FY10
Component/Subsystem Dev						
• Virtual Prototypes						
• Component Design						
• Subsystem Fab/Tests						
• Integrated Tests						
Prototype Development			Award Contracts			
Operational Demos						

Purpose:

Provide the capability to rapidly adjust missile payloads to match target profiles or operational needs for Soldier and UGV platforms.

Product:

- *Low cost guidance*
- *Sensor miniaturization*
- *Enhanced warhead/fuze performance*
- *Motor fire from enclosure, IM*

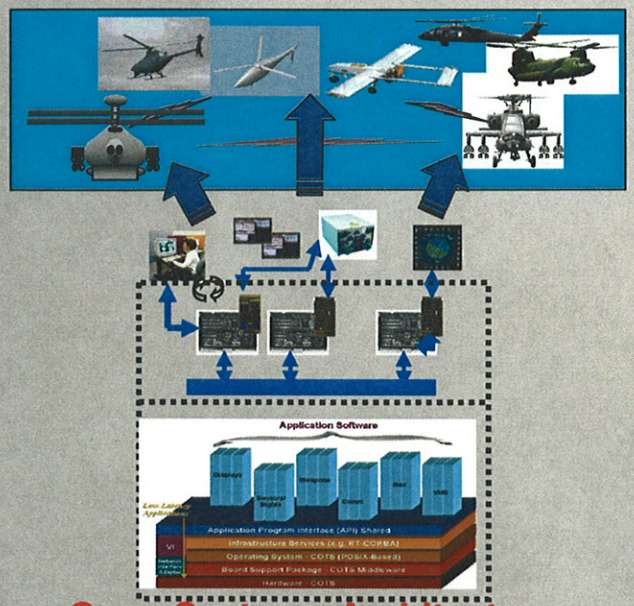
Payoff:

- *Scaleable effects, lethal and non-lethal*
- *Improved survivability and tactical flexibility*
- *LOS fires in mounted operations*

Technical Challenges:

- *Sensor miniaturization*
- *Guidance integration*
- *Warhead enhancements*

Manned-Unmanned Common Architecture Program (MCAP)



Open Systems Architecture

Schedule and Cost

Milestones	*FY03*	*FY04*	*FY05*
Requirements Analysis, Comparison, and Trade/off, Manned-Unmanned Coordination, Standards Selections			
Manned Systems/UAV Harmonization, HW/SW Architecture Design/Checkout			
HW/SW Architecture Detailed Design, Integration, and Functional Tests			
Flight Preparations & Demonstrations			

Purpose:

Enable Army Aviation to use modular COTS electronics and open systems interface standards for advanced mission processing.

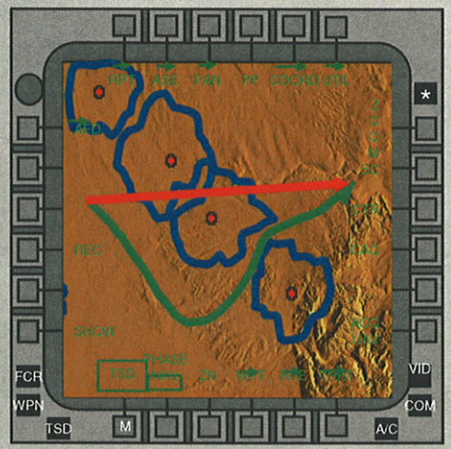
Product:

- *Prototype mission avionics computing system*
  - *Bus – Fibre Channel, Ethernet, 1553B*
  - *Processors – PowerPC G4 minimum*
  - *Backplane – up to 5 GHZ (Fibre Channel/VME, cPCI, Ethernet)*
  - *Mezzanine Cards*
  - *Standard Form Factor – 6U / 3U*
  - *Portable Operating System (POSIX) & OpenGL Graphics*

Payoff:

- *Enhances future force battle command, mission performance, information flow, and avionics affordability*
- *Transitions to PEO AVN in FY06 for Apache Block III Upgrade and to UAVs*

Manned-Unmanned Rotorcraft Enhanced Survivability (MURES)



Cooperative Manned-Unmanned Team Survivability

Schedule and Cost

Milestones	*FY04*	*FY05*	*FY06*	*FY07*
Develop Agents and Susceptibility S/W				
Develop Threat Lethality Predictor				
Integrate Into Unmanned Platform and Demo				
Integrate Into Manned Platform and Demo				

Purpose:

- Develop a real-time Survivability Associate Re-Router tailored to small unit manned-unmanned team operations
- Eliminates the need to provide complete self-protection suite to each element of manned-unmanned team
- Threat countermeasures can be distributed among team and activated through integration into existing unmanned and manned mission management/decision-aiding systems, saving payload

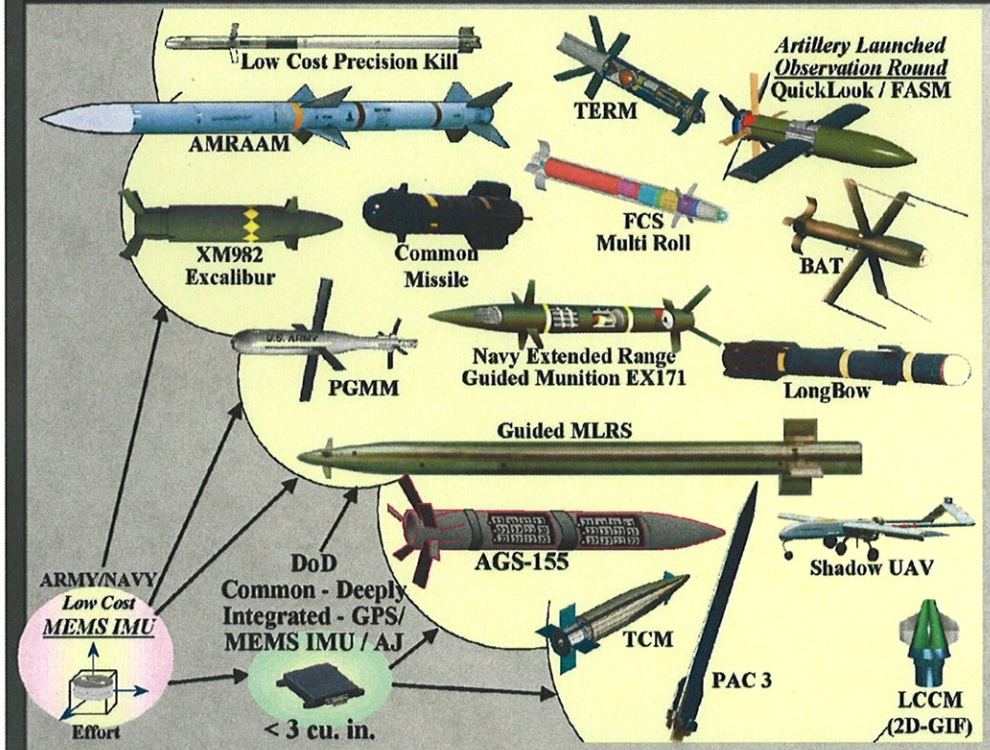
Product:

Real-Time Survivability Associate Re-Router Software.

Payoff:

- Increased survivability of warfighter and aircraft
- Transitions to:
  - UCAR FY06
- Potential:
  - Apache Block III, FY07
  - FCS Block II, FY09

MEMS/IMU for Common Guidance



ACTIVITY \ FY	01	02	03	04	05	06	07
Consolidate IMU Requirements							
Devel Com Guidance ICD/Spec							
Process Enhancements							
Electronics Integration							
Evaluate and Refine Enhanced Processes and Equipment							
Fab IMU Prototypes/Conduct MEMS IMU & DI-GPS/ISA Demos		P1	P2			P3	
IMU Qual & Test Bed Integ.							
DI GPS/ISA Development OPT 1							
DI GPS/ISA Qual & Test Integ.							

Purpose:

The Army is pursuing technologies to meet transformation goals of a lighter, faster, more lethal, greatly reduced logistics footprint. Munitions and missiles are a major contributor to the logistics footprint and essential to increased lethality.

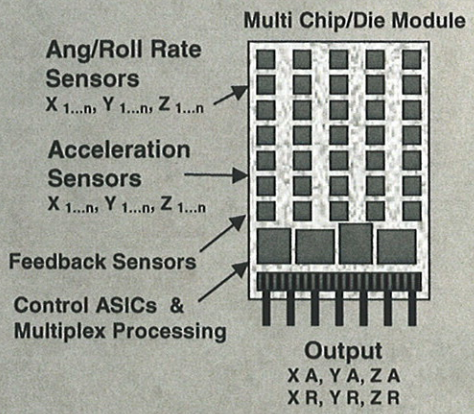
Product:

- ***Minimum of two manufacturers capable of producing affordable MEMS inertial & GPS devices for military needs***
- ***Prototype MEMS IMUs & GPS/ISA for XM982, PGMM, ERGM, TCM, AGS, FCS, APKWS, CM & FCS multi-roll evaluation***

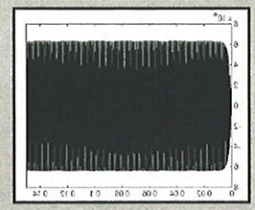
Payoff:

- ***MEMS IMUs and DI-GNU for 90% of DoD tactical systems***

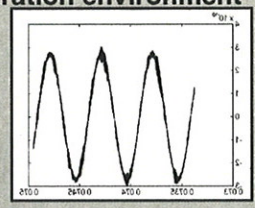
Micro Controlled Arrays (μCAS)



Model Simulation



MEMS ARS output in high-vibration environment



MEMS ARS output in high-vibration environment with aaccelerometer feedback

Purpose:

Provide capability to FCS via CKEM and RRAPDS for increased performance at lower cost. Shift the microsystems paradigm to a system-of-systems concept, incorporating multiple economy-of-scales micro devices to achieve military performance levels.

Product:

- *A methodology for developing array architecture*
- *A beyond mil-spec MEMS temperature sensor array*
- *A vibration-stabilized MEMS ARS array*
- *An expanded-range accelerometer array*
- *An integrated inertial array incorporating the above*

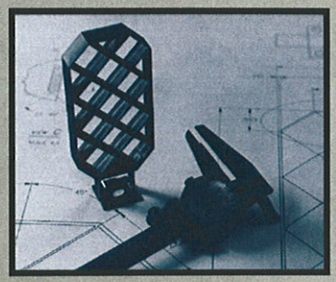
Payoff:

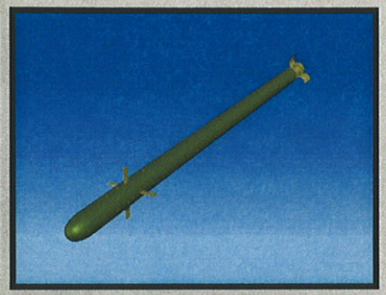
- *Low cost sensor systems with improved performance and new capabilities for extreme environments sensing*
- *Transitions:*
  - *Temp array to RRAPDS, end FY03*
  - *Stabilized gyro to APKWS & CKEM, end FY04*
  - *Accel array to CKEM, end FY05*

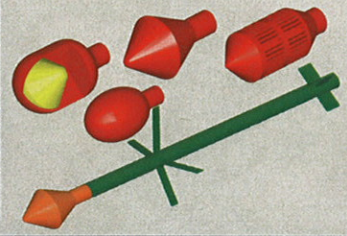
Schedule and Cost

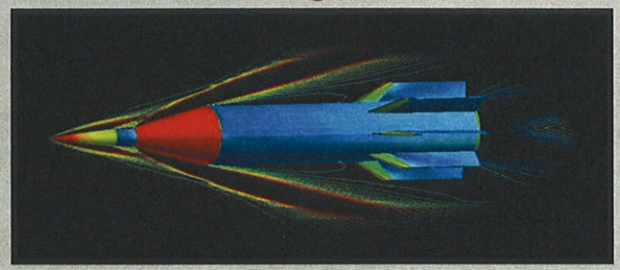
Milestones	*FY03*	*FY04*	*FY05*
Concept Modeling			
Expand Temp Range for RRAPDS			
Integrate Accel FB with ARS			
Accelerometer Bank/Array			
Integrate Arrays & Test			

Missile Aerodynamics Technology Aero Design, Analysis &Test









Schedule and Cost

MILESTONES	FY05	FY06	FY07	FY08	FY09	FY10
Non-Cylindrical Body						
WAF Induced Force Modeling						
Aero Control for Small Missiles						
Aero Considerations for CIAPS						

Purpose:

Enabling technology investigations to enhance the Army's understanding of aerodynamic phenomenon associated with future missile geometry trends and to provide more aerodynamically efficient airframes and control methods.

Product:

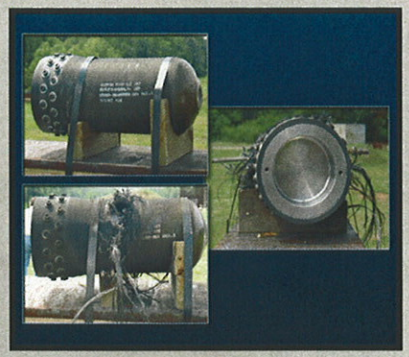
- ***Validated WAF Induced Force Characterization Methodology***
- ***Experimental Data to Characterize Numerous Compact Aerodynamic Control Methodologies***
- ***Experimental Data to Characterize Non-Cylindrical Missile Bodies***

Payoff:

- **Longer Range, Precision Hit/Kill, Lighter, Smaller, and Faster Missiles, Enhanced Maneuverability**
- ***Transitions to AMRDEC 6.3 Tech Demos***

Missile Propulsion IM Technology

Current Minimum Smoke Propellant



IM Candidate Propellant
- *Passed BI/FI*
- *Failed Fielding Requirements*

Purpose:

Demonstrate IM technology to significantly increase warfighter survivability

-For minimum smoke motors, APKWS, JCM, NLOS-LS

-For high performance, large motors, GMLRS, MEADS, SLAMRAAM

Product:

- ***IM technologies (propellants, integrated venting and/or barriers) that increase survivability, reduce hazards classification, and improve logistics while meeting performance requirements***
- ***Reduction in level of reaction to required IM tests (SD, SCJ, FCO, SCO, FI, BI)***

Payoff:

- ***Improve probability of crew/platform survivability***
- ***Increased safety in transportation and storage***
- ***Available technology to transition to 6.3 munition STOs, ATDs, and acquisition programs***
- ***Spiral insertion of IM technologies for PEO TM & PEO ASMD***

Schedule and Cost

Milestones	*FY04*	*FY05*	*FY06*	*FY07*	*FY08*	*FY0*
Propellant Development						
Prototype Mitigation						
Propellant/Venting Demo						
Shock (Barrier) Mitigation						
Final Mitigation Demo						

Networked UAV System Demonstration

Schedule and Cost

Milestones	FY06	FY07	FY08	FY09	FY10
Studies, Preparation					
DA on Manned Helo					
UAV Autonomy					
Simulation					
UAV/ACFT Integration					
Flight Demos					

Objective:

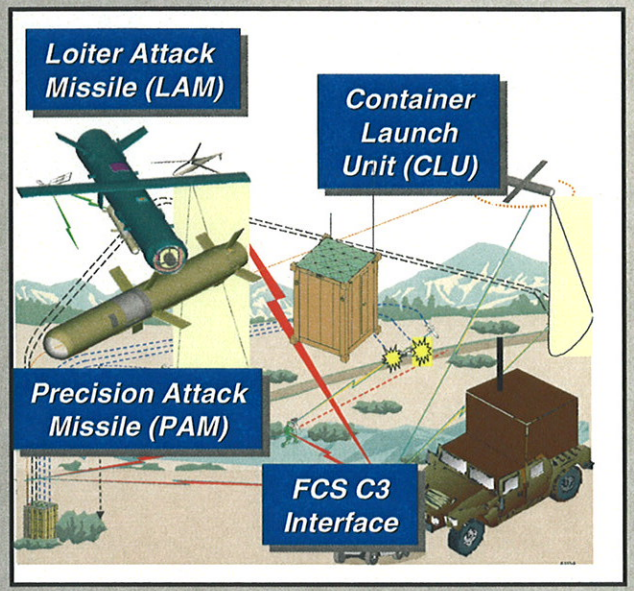
This effort will advance decision aiding, UAV intelligence, common architecture standards, and human interfaces to demonstrate the operational synergy, efficiency, and effectiveness that results from intelligent teaming of smart, networked UAVs. It will mature behaviors/TTPs/Conops through simulation and validate through flight demonstrations.

Approach:

- ***Build on RPA, HSKT/AMUST-D, UACO, MCAP, & SPAR work and AFRL/DARPA/academia***
- ***Advance/infuse decision aiding on manned platform for UAV control use of ground & distributed assets***
- ***Increase UAV autonomy***
- ***Offer UAV autonomy extensions for MCAP, JAUS, FCS SoSCOE and NATO 4586***
- ***Experiment with behaviors, TTPs, and Conops in simulation***
- ***Validate in flight***

Non Line of Sight - Launch System (NLOS-LS) Technology

Responsive, Precision Attack of High-Payoff Targets



Schedule and Cost

Milestones	FY04	FY05	FY06	FY07
Subsystem Design/Dev/Test:				
PAM Seeker	■	■	■	■
LAM Seeker	■	■	■	■
Propulsion Maturation	■	■	■	■
Tandem Warhead Integration	■	■	■	
Objective System Studies	■	■	■	■
Design/Development of Critical Tech	■	■	■	■

Purpose:

Develop/mature improved components and subsystem technologies for the NLOS-LS missile system.

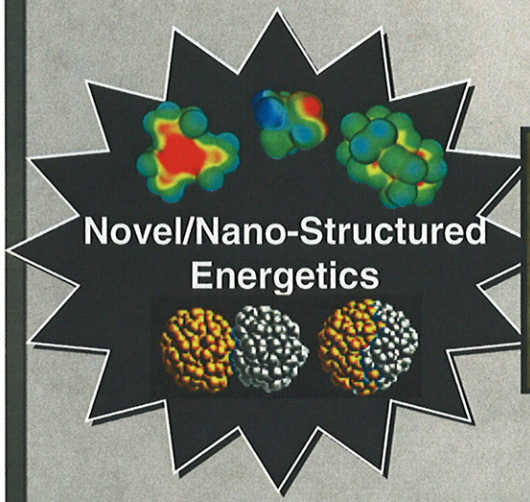
Product:

- ***Improved Seekers for Better Resolution***
- ***IM Controllable Propulsion Maturation***
- ***Warhead Subsystem Integration and Testing***
- ***Validated Simulation Models and Performance Studies***

Payoff:

- ***Affordable NLOS-LS Missile with Improved Performance***
- ***Advanced Imagery to Enhance Target Detections and Battle Damage Assessment***
- ***Extended Range/Increased Loitering Time***
- ***Increased Lethality Against Expanded Target Sets and Environments***

Novel Energetic Materials for the Objective Force



Schedule and Cost

Tasks	FY03	FY04	FY05	FY06	FY07
• Identify candidate novel/nano-energetics (molecular simulations, synthetic chemistry)					
• Downselect most promising concepts					
• Laboratory evaluation of energetic concepts					
• Define energetic materials for weapons systems applications (propellant/explosive formulationTBX)					
• Experimentally assess systems/configurations that exploit energy management					
• Extend/validate modeling tools for energy managed systems					
• Demonstrate potential improvement of energy managed system (propulsion/warhead)					
• Downselect a system for demonstration of novel energetic material (propulsion/warhead)					
• Design, fabricate, demonstrate energy managed system for improved performance					

Purpose:

Mature advanced energetic materials to provide:

- *40% increase in deliverable energy from advanced gun propellant systems*
- *20-50% increase in warhead effectiveness (munitions, active protection)*
- *40% decrease in munitions vulnerability*

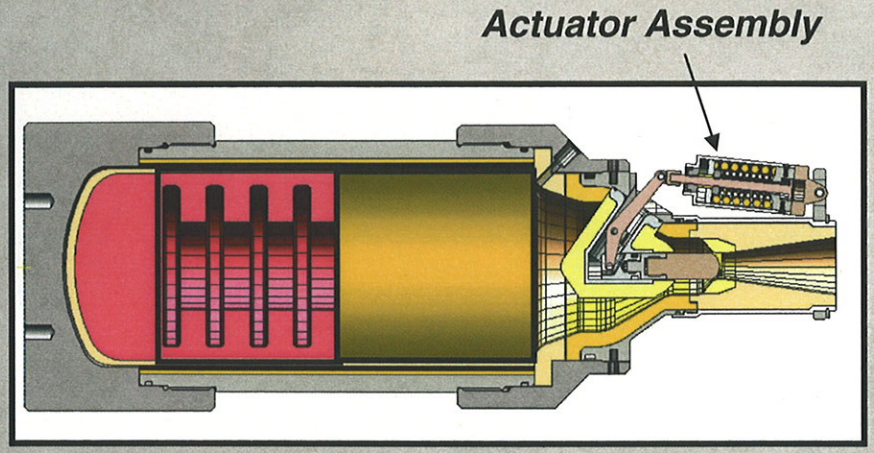
Product:

- *Demonstration of advanced energetic materials with ability to tune energy release for precision munition & counter-munition applications (e.g., propellants, explosives, thermobarics, multi-purpose warhead, APS)*

Impact:

- *Mission-enabling lethality at range and crew survivability under ambush for the full range of Objective Force weapons systems and emerging/unforeseen classes of new weapons*
- *Transitions to ARDEC/AMRDEC for FCS Increment 2 upgrades*

Passive Variable Area Nozzle (VAN)



Typical Tactical Missile Rocket Motor

Purpose:

Develop low cost controllable propulsion system for tactical missiles.

Product:

- ***Passive VAN Concept Design Using Low Cost Materials***
- ***Smaller, Lower Cost Actuators Suitable for Precision Attack Missile (PAM), Joint Common Missile (JCM), and Other Tactical Missiles***

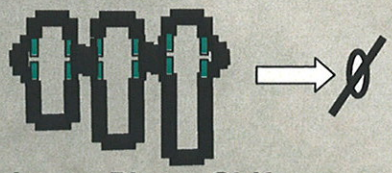
Schedule and Cost

Milestones	FY04	FY05	FY06	FY07
System Level Concept Studies				
Downselect Two VAN Concepts				
Design/Fabricate Component Hardware				
Demonstration Components				
Integrated System Static Tests				

Payoff:

- ***10-15% Increased Range and Greater Mission Flexibility***
- ***Variable Thrust Provides Choice of Extended Standoff Range or Shorter Time-of-Flight***
- ***Improved Insensitive Munitions Characteristics***
- ***Potential Cost Avoidance of $2k/Missile Over Active Variable Nozzle Designs***

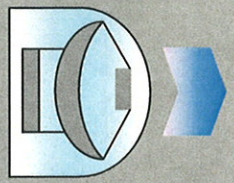
Phased Arrays for Tactical Seekers

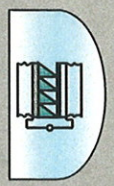


Miniature Phase Shifter

MEMS Switch

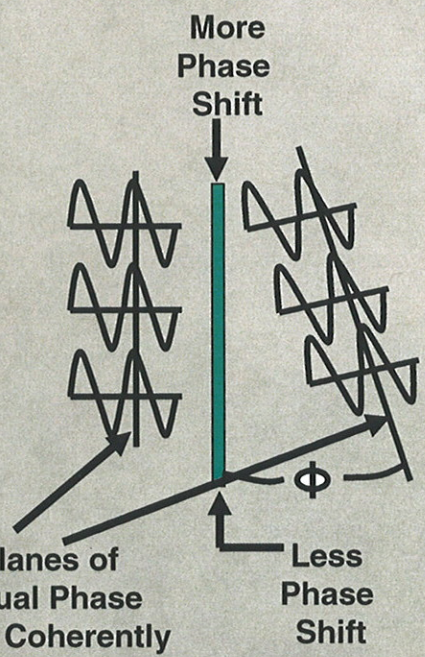
Conventional Gimbaled Antenna





No Moving Parts XY Scanner

Passive Phased Array



Schedule and Cost

Milestones	*FY04*	*FY05*	*FY06*	*FY07*	*FY08*
Fab/Test RF PACs in Lab					
Fab/Test Optic PACs in Lab					
Demo Phase Shifters in Lab					
Fab/Demo Sub-Array (RF DL & LADAR Seeker) Using Phase Shifters					
Demo Sub-Array (RF Seeker)					

Purpose:

Develop MEMS-based or alternative low-cost phased arrays to provide rapid beam steering for sensors, RF seekers and data links, and optical/LADAR seekers in support of Future Combat System.

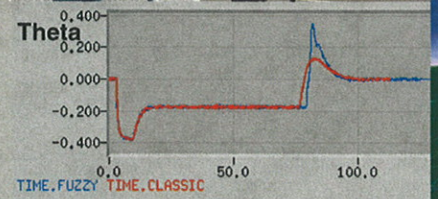
Product:

- *Low-Cost Phased Array Components and Designs*
- *RF Sub-Arrays*
- *Optical Sub-Arrays*
- *Integrated Sub-Arrays/Phased Arrays*

Payoff:

- *Improved Lethality and Reliability Without Cost Increase*
- *Increased Target Search Speed*
- *Increased Range of High Bandwidth Data Links*
- *Transition Components, Designs, & Test Data to NLOS-LS BLK-II Follow-on in FY07 & Joint Common Missile P3I/BLKUpgrade in FY08*

Precision Autonomous Landing Adaptive Control Experiment (PALACE)



Schedule and Cost

Milestones	FY03	FY04	FY05
Define Control Law Architecture			
Implement in Real-Time Simulation, Including Prototyping GCU Display			
Simulation Evaluation, Control Law Sensor Optimization			
Complete Associated Flight Vehicle Mods			
Test Matrix In-Flight, Publish Results			

Purpose:

Autonomous precision UAV VTOL to unprepared sites in variable winds for perch and stare surveillance, precision UAV supply delivery, recovery, and FARP operations.

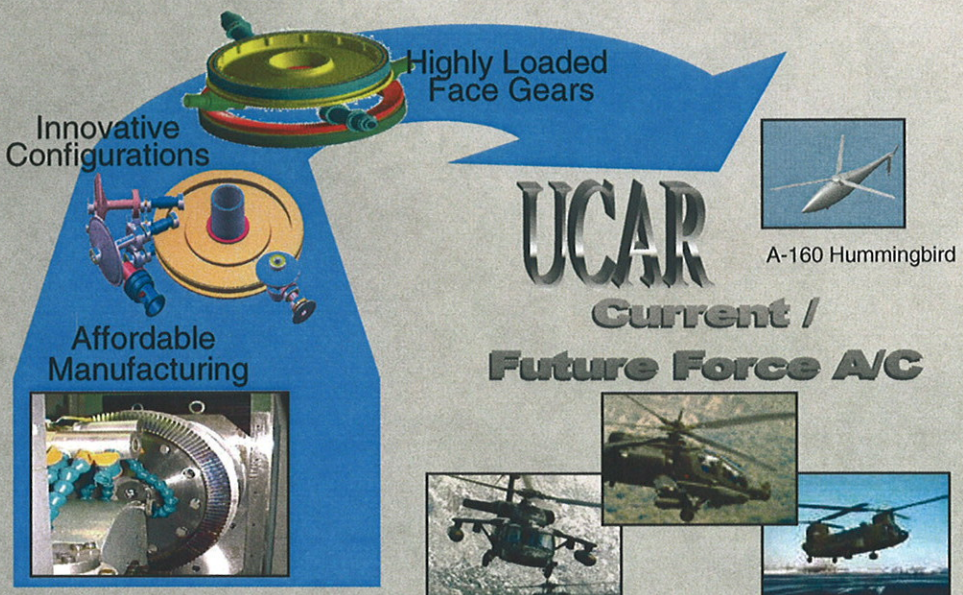
Product:

Performance criteria, methods and flight proven adaptive control techniques for precision helicopter landing at arbitrary sites. Includes full nonlinear vehicle dynamics, control laws, sensor, and actuator models.

Payoff:

- ***Reduces UAV reliance on prepared landing sites***
- ***Reduces manpower***
- ***Reduces VTOL crashes***
- ***Allows precision UAV critical supply delivery.***
- ***Allows perch and stare surveillance capabilities***
- ***Provides capability for UAV FARP Ops without returning to home***
- ***Transitions to DARPA Obstacle Avoidance MAV. 6.3 follow on work via A-160. Portions applicable UCAR, UCL & AMRDEC 6.3 UAV vehicle mgt system demos***

Rotorcraft Drive Systems for the 21st Century (RDS – 21)



A-160 Hummingbird

UCAR

Current / Future Force A/C

Schedule and Cost

Milestones	FY01	FY02	FY03	FY04	FY05
Preliminary Design					
Detailed Design					
Fabrication					
Component Testing					
Demo Testing					

Purpose:

- *Demonstrate a major advancement in rotorcraft drive system performance and affordability applicable to future manned and unmanned aircraft of the Future Force.*

+35% SHP/WT
-12 dB Noise (Cabin Center)
-20% O&S Costs
-20% Production Cost

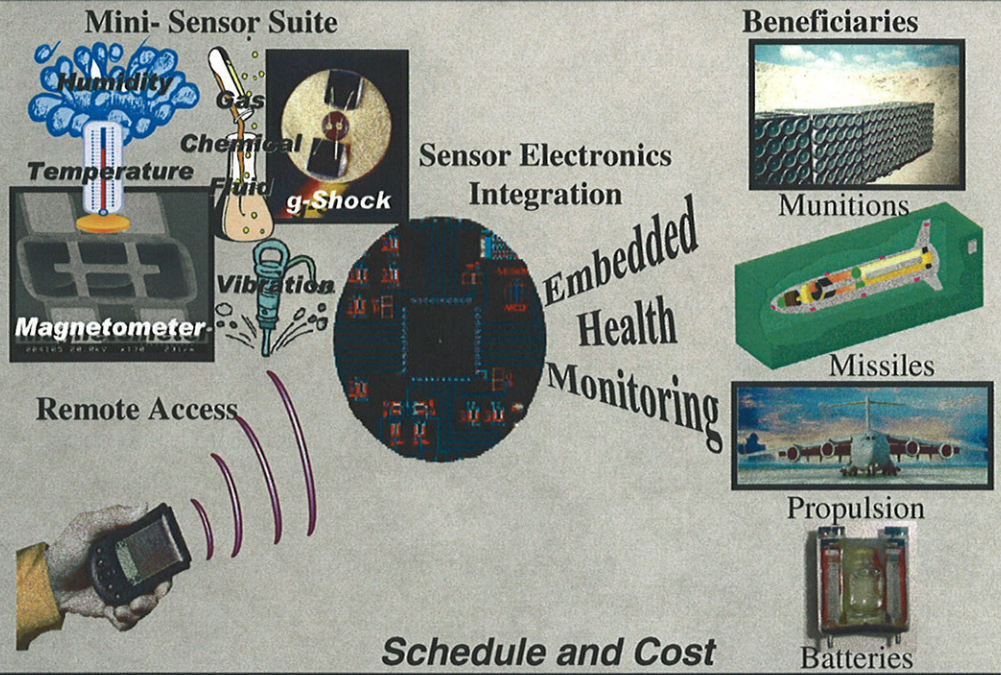
Product:

- *Low weight, high performance drive system with reduced cost of ownership*
- *Validated advanced design tools and modeling techniques*
- *Results documented in final report*

Payoff:

- *Increased SHP/WT provides A/C with increased range and payload capability*
- *Reduced O&S and production costs increase aircraft affordability (achieved through reduced maintenance costs)*
- *Transitions to AH-64 Block III for FY06 SDD*
- *Designs transitioned to UCAR A/C demonstrators*

Sensor & Electronics P/D for FCS



Schedule and Cost

MILESTONES	FY04	FY05	FY06	FY07	FY08
RRAPDS Improvements (Gen-II)					
g-Shock Sensor					
Vibration Sensors					
Communications					
Gas/Chemical/Fluid Sensor					
P/D Validation-Threshold Failures					
Multi-Function Sensor Integration					

Purpose:

- *Develop embedded diagnostics sensors and on-board prognostics capabilities to monitor system health*
- *Develop remote access to diagnostics and prognostic estimations for commanders and logisticians*

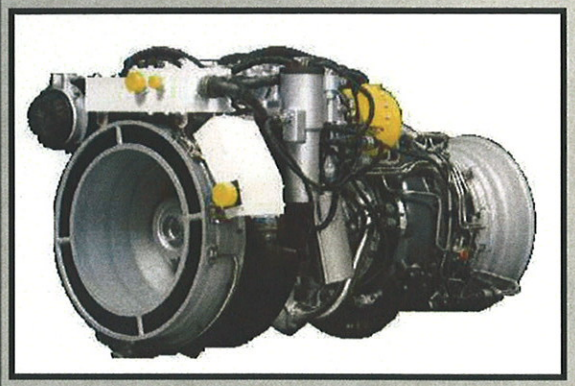
Product:

Compact sensor platform having the capability to provide prognostics and diagnostics of systems where g-shock, temperature, humidity, vibration and gas/chemical/fluid sensing are needed for system health monitoring.

Payoff:

- *Enhanced awareness of system condition*
- *Increased readiness and reliability of Future Combat Systems*
- *Smaller logistics foot print with condition-based maintenance*
- *Increase confidence of mission completion*
- *Transition to NLOS-LS Spiral 2, PGMM, MERM, Excalibur*

Small Heavy Fuel Engine



Purpose:

Develop small heavy fuel engine to enable required range and payload for future UAVs.

Product:

- ***Provides reliable heavy fuel propulsion capability for A-160, Fire Scout, and other UAVs***
- ***Scalable technology and design tools to support Future Force engine development efforts***

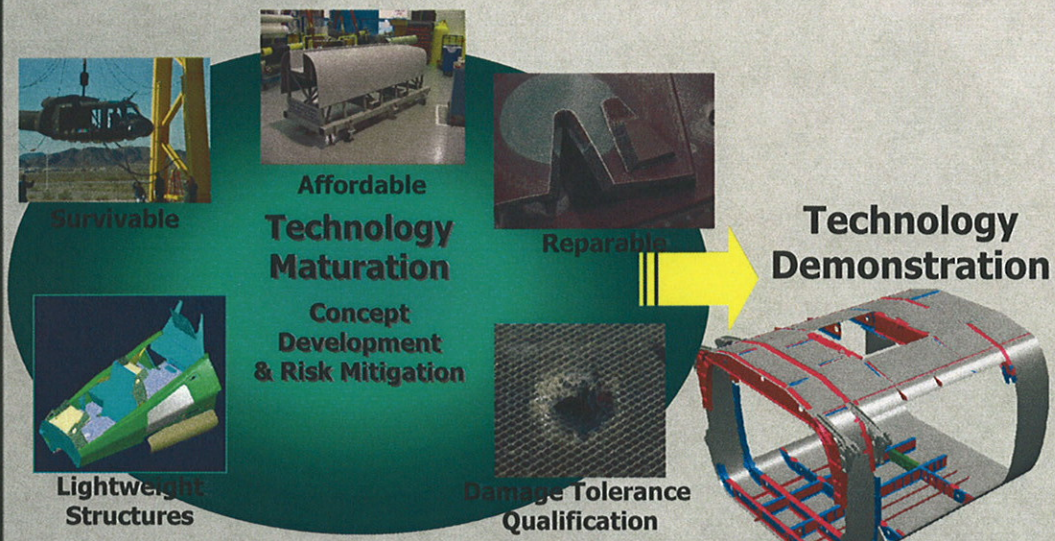
Schedule and Cost

Milestones	FY04	FY05	FY06	FY07
SHFE Design				
SHFE Fabrication				
SHFE Component Test				
SHFE Test				

Payoff:

- ***Provides future UAVs with SHFE capability that enables affordable range and payload capability***
- ***Reduced logistic footprint***
- ***35% reduction in production and maintenance cost***

Survivable, Affordable, Reparable Airframe Program (SARAP)



Purpose:
Demonstrate a major advancement in airframe affordability, weight, survivability, and supportability for manned and unmanned objective force rotorcraft.

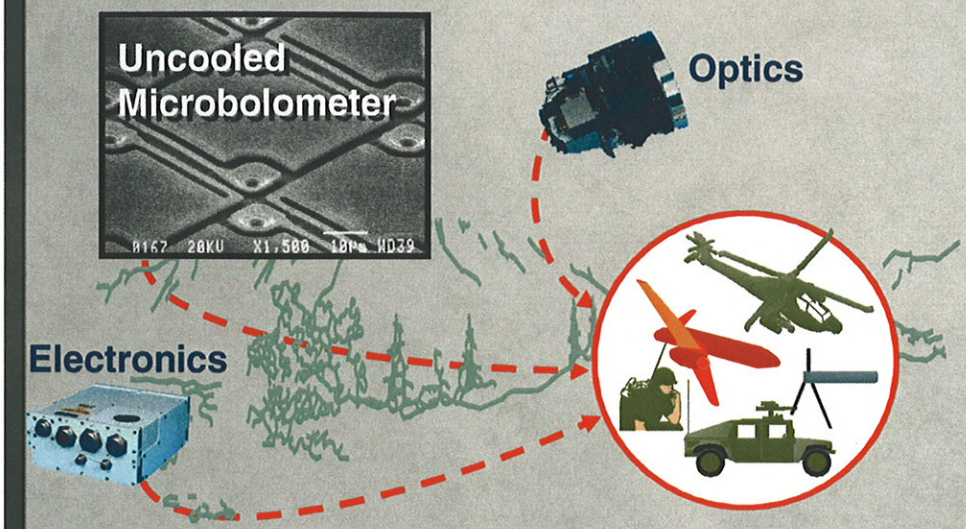
Product:
- Validated virtual prototype capability (TRL6) for structures
  - 100% model-based definition
  - Full-scale demo/validation article
- Crashworthy and ballistic tolerant airframe concepts (TRL7)
- Durable, inspectable, reparable concepts (TRL7)

Payoff:
- 28% improvement in payload or 54% increase in range
- Improved survivability, availability, and performance
- Reduce life-cycle costs
  - Block III UH-60/FUR
  - A-160

Schedule and Cost

Milestones	*FY02*	*FY03*	*FY04*	*FY05*	*FY06*
Durability & Dam Tol Design Criteria					
Adaptive Landing Gear					
Adaptive Vibration Control					
Virtual Prototype					
Crash/Ballistic Test					
Reparability Demonstration					
Full Scale Static Test					

Uncooled Infrared Technology for Missile Seekers



Schedule and Cost

Milestones	FY02	FY03	FY04	FY05	FY06	FY07
Lab Test Bed						
Field Test Bed						
Electronics/Optics						
G&C Techniques						
Enhanced NetFires						

Purpose:

Provide NLOS-LS with the maximum capability to achieve overall system effectiveness through the application of uncooled IR technology by demonstrating uncooled IR concepts for lock-on-after-launch and lock-on-before launch missile seekers, providing maximum performance at an affordable cost.

Product:

- *Quantitative analysis of detectors*
- *Laboratory and field characterization*
- *Optimized optical packages*
- *Sensor specifications*
- *Enhanced NLOS-LS PAM Seeker (640x480 EPAM Seeker)*

Payoff:

- *Warfighting operational benefits*
  - *Lower cost systems, increased reliability*
  - *Instantly responsive, reusable systems*
- *Transitions plans for NLOS-LS SDD*
  - *Uncooled IR Models in Jun 04*
  - *EPAM Seeker to NLOS-LS in May 06*
  - *Advanced uncooled IR in FY 07*

Unmanned Autonomous Collaborative Operation

Purpose:

Provide capability for UAVs to act in concert with manned vehicles and work as a team to accomplish mission-level objectives with minimal human intervention or control.

Product:

- ***Software for UAV Collaboration and Autonomy***
- ***Requirements for Software, Sensors, Processors, and Data Links***
- ***UAV Cooperative Engagement Capability***

Schedule and Cost

Milestones	FY04	FY05	FY06	FY07
ACO Behavior Defn, Tech Assess				
Reqmts Analysis/Prelim Design				
System Architecture & Software Design				
Software Development				
Hardware Integration				
Simulation/HWIL Lab Evals				
Flights/Demos (incl. C2ORE)				
Transition of Behaviors				

Payoff:

- ***Integrated Manned-Unmanned & Unmanned-Unmanned Vehicle Team Operations***
- ***More Attention to Critical Mission Elements***
- ***Increased Soldier/System Lethality***
- ***Transitions to UCAR, FCS Spiral Development, Further 6.3 S&T Programs***

ACRONYMS AND ABBREVIATIONS LIST

A2C2S	Army Airborne Command and Control System
A/C	Aircraft
ABCS	Army Battle Command Systems
ACF	Autonomous Collaborative Flight
ACFT	Aircraft
ACTD	Advanced Concepts Technology Demonstration
AF	Air Force
AFRL	Air Force Research Laboratory
AFSOC	Air Force Special Operations Command
AGS	Armored Gun System
AJ	Antijam
AMD	Air and Missile Defense
AMMPGM	Advanced Miniature Multi-Role Precision Guided Missile
AMRAAM	Advanced Medium Range Air-To-Air Missile
AMRDEC	Aviation and Missile Research, Development, and Engineering Center
AMUST-D	Airborne Manned-Unmanned Systems Technology Demonstration
APEX	Advanced Prototyping, Engineering, and eXperimentation
APKWS	Advanced Precision Kill Weapon System
APAS	Active-Passive Aircraft Survivability
APS	Active Protective System
ARDEC	Armament Research, Development, and Engineering Center
ARH	Anti-Radiation Homing
ARL	Army Research Laboratory
ARM	Antiradiation Missile
ARS	Angular Rate Sensor
ASC	Advanced Simulation Center
ASIC	Application-Specific Integrated Circuits
ASTMIS	Army Science and Technology Management Information System
ATA	Air-to-Air
ATACMS	Army Tactical Missile System
ATD	Advanced Technology Demonstration
AV	Air Vehicle
AVGAS	Aviation Gasoline
AVN	Aviation
BAT	Brilliant Anti-Tank
BDA	Battle Damage Assessment
BI	Bullet Impact
BLK	Block
BLOS	Beyond Line-of-Sight
BVRE	Beyond Visual Range Engagements

ACRONYMS AND ABBREVIATIONS LIST (Continued)

C2	Command and Control
C3	Command, Control, and Communications
C4ISR	Command, Control, Communications, and Computer Intelligence Surveillance and Reconnaissance
CAD	Computer Aided Design
CAS	Controlled Arrays
CCM	Counter-Countermeasures
CDR	Critical Design Review
CECOM	Communications-Electronics Command
CERDEC	Communications-Electronics Research, Development, and Engineering Center
CFD	Computational Fluid Dynamics
CIAPS	Close-In Active Protection System
CLU	Command Launch Unit
CKEM	Compact Kinetic Energy Missile
CM	Common Missile, Countermeasure, Cruise Missile
CMS	Counter Mortar System
CMWS	Common Missile Warning System
CONOPS	Concept of Operations
COTS	Commercial Off the Shelf
COSSI	Commercial Operating and Support Savings Initiative
CSS	Contract Support Sets
DARPA	Defense Advanced Research Projects Agency
DBBL	Dismounted Battlespace Battle Laboratory
DI	Deeply Integrated
DIS	Distributed Interactive Simulation
DL	Data Link
DOF	Degree of Freedom
DRAM	Dynamic Random Access Memory
DRFM	Digital Radio Frequency Modulator
EAPS	Extended Area Protection and Survivability
EEPROM	Electrically Erasable Programmable Read Only Memory
EO	Electro-Optical
EPAM	Enhanced Precision Attack Missile
EPLRS	Enhanced Position Location Reporting System
ER	Extended Range
ERGM	Extended Range Guided Munitions

ACRONYMS AND ABBREVIATIONS LIST (Continued)

FARP	Forward Arming and Refueling Point
FASM	Field Artillery Smart Munitions
FB	Feedback
FC	Fire Control
FC-NET	Fire Control – Node Engagement Technology
FCO	Fast Cook-Off
FCR	Fire Control Radar
FCS	Future Combat System
FF	Future Force
FI	Fragment Impact
FLIR	Forward Looking Infared
FOC	Force Operating Capability
FPA	Focal Plane Array
FPGA `	Field Programmable Gate Arrays
FUR	Future Utility Rotorcraft
G&C	Guidance and Control
GCS	Ground Combat System, Ground Control Station
GCU	Guidance and Control Unit
GEMS	Guidance Electronics Miniaturization and Structronics
GIF	Guidance Integration Facility
GMTI	Ground Moving Target Indicator
GMLRS	Guided Multiple Launch Rocket System
GNU	Guidance and Navigation Unit
GPS	Global Positioning System
HIMARS	High Mobility Artillery Rocket System
HITL	Hardware-In-The-Loop
HMMWV	High Mobility, Multipurpose Wheeled Vehicle
HP	Horsepower
HSKT	Hunter Stand-Off Killer Team
HTI	Horizontal Technology Integration
HUMS	Health and Usage Monitoring System
HW	Hardware
HWIL	Hardware In-The-Loop
ICBM	Intercontinental Ballistic Missile
ICD	Interface Control Document
IDA	Intelligence Decision Aiding for Survivability
IFF	Identification, Friend or Foe
IIR	Imaging Infrared
IM	Insensitive Munitions
IMU	Internal Measurement Unit
IR	Infrared

ACRONYMS AND ABBREVIATIONS LIST (Continued)

IRBM	Intermediate Range Ballistic Missile
IRCM	Infrared Countermeasures
ISA	Inertial Sensor Assembly
JAHUMS	Joint Advanced Health and Usage Monitoring System
JAUS	Joint Architecture for Unmanned Systems
JCM	Joint Common Missile
JPO	Joint Project Office
JSOW	Joint Standoff Weapon
JTA-A	Joint Technical Architecture—Army
JTAGG	Joint Turbine Advanced Gas Generator
JTF	Joint Task Force
JTRS	Joint Tactical Radio System
KE	Kinetic Energy
KEM	Kinetic Energy Missile
Km	Kilometer
LADAR	Laser Radar
LAM	Loitering Attack Missile
LAV	Light Armored Vehicle
LCAR	Low Cost Active Rotor
LCCM	Low Cost Cruise Missile
LCPK	Low Cost Precision Kill
LNS	Land Navigation System
LOS	Line-Of-Sight
LOSAT	Line-Of-Sight Antitank
LOS-SLC	Line-Of-Sight Smaller Lighter Cheaper
L-RAM	Long-Range Aviation Missile
MANPADS	Man Portable Air Defense System
MAS	Maneuver Ammunition Systems
MAV	Manned Aerial Vehicle; Micro Air Vehicle
MCAP	Manned-Unmanned Common Architecture Program
MEADS	Medium Extended Air Defense System
MEMS	Micro Electro-Mechanical System
MERM	Multi-Purpose Extended Range Munition
MIL	Man-in-the-Loop
MLRS	Multiple Launch Rocket System
MOSP	Multi-Optronics Stabilized Payload
MOUT	Military Operations in Urban Terrain
MP	Multi-Purpose
MRBM	Medium Range Ballistic Missile
MRM	Medium-Range Missile

ACRONYMS AND ABBREVIATIONS LIST (Continued)

MSB	Milestone B
MUM	Manned-Unmanned
MURES	Manned-Unmanned Rotorcraft Enhanced Survivability
NAI	National Aerospace Initiative
NATO	North Atlanic Treaty Organization
NLOS	Non Line-of-Sight
NLOS-LS	Non Line-of-Sight Launch System
NRTC	National Rotorcraft Technology Center
NUGAS	Networked Unmanned Ground and Air System
O&S	Operating and Support
OCSW	Objective Crew Served Weapon
OFW	Objective Force Warrior
ORD	Operational Requirements Document
PAC	Patriot Advanced Capability
PALACE	Precision Autonomous Landing Adaptive Control Experiment
PAM	Precision Attack Missile
PATS	Phased Arrays for Tactical Seekers
P/D	Prognostics/Diagnostics
PE	Program Element
PEO	Program Executive Officer
PK	Probability of Kill
PGMM	Precision Guided Mortar Munitions
PKAT	Precision Kill Autonomous Targeting ask Bill Nourse
PM	Project/Program Manager
PO	Project/Program Office
RAM	Reliability, Availability, Maintainability
RCS	Radar Cross-Section
RDECOM	Research, Development, and Engineering Command
RDS	Rotorcraft Drive system
RF	Radio Frequency
RPA	Rotorcraft Pilot's Associate
RPG	Rocket Propelled Grenade
RPM	Revolutions Per Minute
RRAPDS	Remote Readiness Asset Prognostic/Diagnostic System
S&T	Science and Technology
SAL	Semi-Active Laser
SAR	Synthetic Aperture Radar
SARAP	Survivable, Affordable, Reparable Airframe Program
SBIR	Small Business Innovation Research

ACRONYMS AND ABBREVIATIONS LIST (Continued)

SCJ	Shaped-Charge Jet
SCO	Slow Cook-Off
SD	Sympathetic Detonation
SDD	System Development and Demonstration
SEAD	Suppression of Enemy Air Defenses
SEI	Specific Emitter Identification
SFC	Specific Fuel Consumption
SHFE	Small Heavy Fuel Engine
SHP	Shaft Horsepower
SINGARS	Single Channel Ground and Air Radio System
SLC	Smaller, Lighter, Cheaper
SLAMRAAM	Surface-Launched Advanced Medium-Range Anti-Aircraft Missile
SMI	Soldier-Machine Interface
SOS	System of Systems
SOSCOE	System of Systems Common Operating Environment
SPAR	Survivability Planner Associate Rerouter
STO	Science and Technology Objective
SW	Software
TBX	Thermobaric Explosives
TCM	Tri-Service Common Missile
TD	Technology Demonstration
TERM	Tank Extended Range Munitions
TM	Technical Manual
TOC	Tactical Operations Center
TRL	Technology Readiness Level
TTP	Techniques, Tactics, and Procedures
TWP	Target Weapon Pairing
UA	Unit of Action
UACO	UAV Autonomous Collaborative Operation
UAV	Unmanned Aerial Vehicle
UAVS	Unmanned Aerial Vehicle System
UCAR	Unmanned Combat Armed Rotorcraft
UCL	Unmanned Cargo Lifter
UGV	Unmanned Ground Vehicle
UGVS	Unmanned Ground Vehicle System
UFR	Unfunded Requirement

ACRONYMS AND ABBREVIATIONS LIST (Concluded)

VAATE	Versatile Affordable Advanced Turbine Engine
VAN	Variable Area Nozzle
VTOL	Vertical Take-Off and Landing
WAF	Wraparound Fins
WISP	Wideband Infrared Scene Projector
WMD	Weapons of Mass Destruction
WT	Weight

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